

Comparison of C5 and C6 Aqua-MODIS dark target aerosol validation

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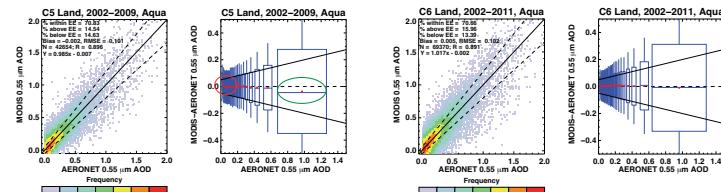
Introduction

- We compare C5 and C6 validation to compare the C6 10 km aerosol product against the well validated and trusted C5 aerosol product on global and regional scales.
- Only the 10 km aerosol product is evaluated in this study, validation of the new C6 3 km aerosol product still needs to be performed. Not all of the time series has processed yet for C5 or C6, and the years processed for the 2 products is not exactly the same (this work is preliminary!)
- To reduce the impact of outlier observations, MODIS is spatially averaged within 27.5 km of the AERONET site, and AERONET is temporally averaged within 30 minutes of the MODIS overpass time. Only high quality (QA = 3 over land, QA > 0 over ocean) pixels are included in the mean.

Global Validation Statistics

Aerosol optical depth over land

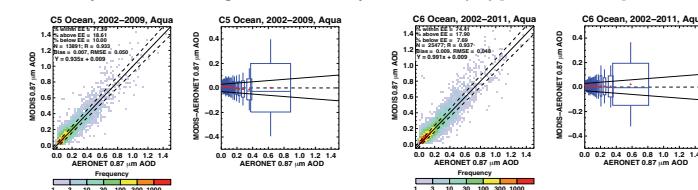
C5 & C6 MODIS-AERONET agreement statistics are similar, but large AODs were underestimated, and small AODs were overestimated in Collection 5. This is not seen in the C6 validation.



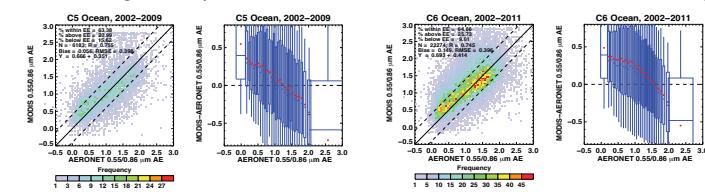
Figures 1 (C5) and 2 (C6): (Left panels): frequency scatter plots for AOD at 0.55 μm over dark-land compared to AERONET, plotted from Aqua-MODIS, computed with C5 algorithm (Fig 1) and C6 algorithm (Fig 2). (Right panels): The same information plotted as AOD error (MODIS-AERONET) versus AERONET, broken into equal number bins of AERONET AOD for C5 (Fig 1) and C6 (Fig 2). One-line (zero error) is dashed and EE envelopes are solid. For each box-whisker, its properties and what they represent include: width is 1σ of the AOD bin, whereas height, whiskers, middle line and red dots are the 1σ, 2σ, mean and median of the AOD error, respectively.

AOD and angstrom exponent over ocean

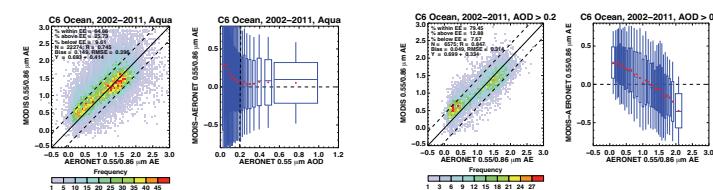
C6 ocean 0.87 μm AOD has a higher % within expected error (EE) [$0.03 \pm 0.05 \text{ AOD}$] than C5



Both C5 and C6 Angstrom Exponent are overestimated at low AE and underestimated at high AE



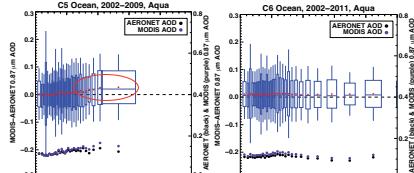
AE error is significantly reduced when AOD > 0.2 (more signal)



Impact of specific improvements

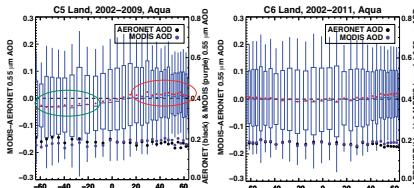
Multiple wind speed LUTs over ocean

- In C5, MODIS-AERONET agreement decreased with increasing wind speed.
- Look up tables with 2-14 m/s wind speeds were introduced for C6 to account for increased ocean surface reflectance at higher wind speeds
- In C6, there is no trend with wind speed

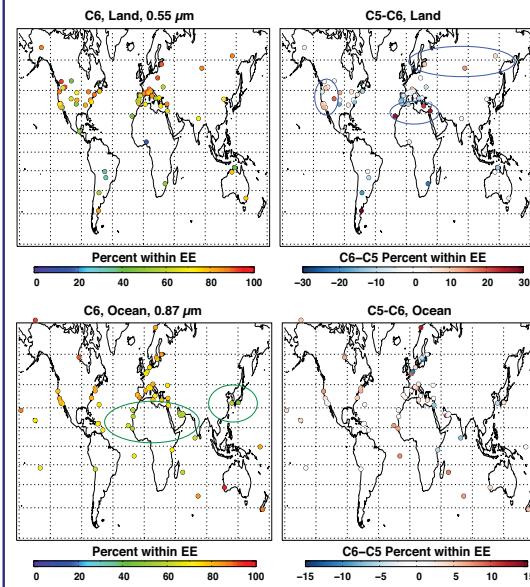


Calibration improvements

- In C5, AOD over land is overestimated on the right side of the scan, and underestimated on the left side of the scan.
- In C6, there is almost no trend in AOD vs. sensor zenith angle, but some overestimation is still seen on the right edge of the scan.



Regional Validation



Over land, improvements are seen in difficult to retrieve in regions, including the Northern boreal forests, and the brighter Western US and Mediterranean regions. There are still regions which need improvement, primarily in Africa, India, and South America.

Over ocean, it is clear the dust outflow regions and Asian pollution outflow regions have the poorest MODIS-AERONET agreement, while the retrieval performs very well in the mid- and high latitudes.

Conclusions

- A provisional validation shows the Aqua-MODIS C6 10 km aerosol product validates acceptably for science, and corrects several issues that were identified in the C5 validation.
- The regional validation shows that, despite advances, there is still work to be done, especially in dusty regions over ocean and biomass burning regions in South America and Africa.
- This provisional validation needs to be extended to the end of the time series and Terra-MODIS.
- The impact of sensor degradation on the C6 aerosol data record has not yet been quantified.